Mariner Mars 1971 Mission Support

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All requirements for Deep Space Network (DSN) capabilities needed to support Mariner Mars 1971 Mars orbital operations have been compiled and reiterated with the implementing organizations. Trade-offs between schedule and capability have been made in some instances. This article describes the resulting planned configuration, by network system.

In Technical Report 32-1526, Vol. III, the DSN configuration for support of the *Mariner* Mars 1971 launch and cruise was described. That configuration was significantly different from the one originally planned because of the realities of implementation scheduling. Similar problems have forced a decrease in available DSN capabilities for support of *Mariner* Mars 1971 Mars orbit operations. The resulting configurations, by network systems, are described in the following tables and figures. The method of presentation is the same as in the previous article. Table 1 and Figs. 1 and 2 apply to the telemetry system; Table 2 and Fig. 3 apply to the command system; Table 3 and Figs. 4 and 5 apply to the tracking system; Table 4 and Fig. 6 apply to the monitor system; Table 5 and Fig. 7 to the operations control system; Table 6 and Fig. 8 to the simulation system; and Table 7 to intersystem capabilities. The simulation system will be used to support training for the orbital period.

For each capability listed in a table, a figure reference is given to the corresponding element in the cross-referenced figure; in some cases the block on a figure is numbered and figure reference 2-(1) is interpreted as Fig. 2, Block (1).

The major change that was made between the original plan and the plan described here is that all high-rate telemetry processing and all master data record (MDR) and experiment data record (EDR) processing was eliminated from the 360/75. A plan to interface the Project-supplied mission and test computer(s) (MTC) to the GCF high-speed data lines will be implemented to accomplish these functions.

Table 1. Telemetry system

Planned orbital operations capabilities	Reference
A. DSIF	
1. Hardware ability to demodulate, synchronize and decode all MM'71 data	1-DSIF
2. TCP telemetry software	
a. Acquire synchronized 50 bps through 16.2-kbps telemetry for SSA/BDA	1-TCP
b. Format 50 bps through 2 kbps data and output over HSDL	1-TCP
c. Format selected 50 bps science and output via TTY	1-TCP
d. At DSS 14, format 1-16 kbps data and output over WBDL	1-TCP
e. Record all received data on a digital ODR	1-ODR
3. ODR validation program to operate on TCP	1-TCP
4. Playback specified portions of ODR at HSDL rate	1-TCP
5. Analog record receiver and SDA outputs	1-DSIF
6. Playback analog SDA recording with ground received time	1-DSIF
7. Hardware/software must simultaneously provide:	
a. Command, engineering telemetry (8⅓ or 33⅓, and science telemetry (50 bps, 1 kbps, or 2 kbps) using one 920 computer	1-DSIF
b. 1, 2, 4, 8, or 16 kbps telemetry using second 920 computer (DSS 14 only)	1-DSIF
B. GCF	
1. 50-kbps WBDL from DSS 14 to SFOF	1-WBDL
C. SFOF	
1. 360/75 Telemetry software for engineering (8⅓ or 33⅓) data	
a. Automatic stream selection	2-(2)
b. Place real-time data on SDR	2-(6)
c. Place ODR replay data on SDR (at HSDL rate)	1-360
d. SDR/MDR summary display	2-(6)
e. Fix discrepancies	
(1) Display formats	2-(5)
(2) Special processing—derived channels	2-(4)
2. 360/75 Telemetry software for 50 bps science data	
a. Automatic stream selection	2-(2)
b. Place real-time data on SDR	2-(6)
c. Place ODR replay data on SDR (at HSDL rate)	1-360
d. SDR/MDR summary display	2-(6)
e. Decommutate	2-(3)
f. Display TTY character printer formats	2-(5)
g. Display 1443 formats	2-(5)
h. Display DTV formats	2-(5)
3. 360/75 Telemetry software for all low rate telemetry	
a. SDR recovery after failure	1-360
b. SDR write to tape	1-360
c. Summary processor (statistical)	1-360
d. Recall from SDR for display	2-(6)
e. TAG formats for 1443 (2)	2-(5)
f. TAG DTV formats (2)	2-(5)
g. TAG formats for character printers (2)	2-(5)
h. DSN monitor data in telemetry displays	1-360
i. Telemetry-monitor interface	1-360
j. Continue ground channel processing in absence of telemetry data	1-360

Table 2. Command system

Planned orbital operations capabilities	Reference
A. DSIF	
1. Fix TCP software discrepancies known at launch, including alarms, stack recall	3-TCP
2. Playback to SFOF selected portions of ODR from TCP	3-TCP
B. GCF	
C. SFOF	
1. 360/75 command software	
a. Display alarms consistent with A.1	3-360
b. Generate and validate command SDR	3-360
c. Place ODR replay data on SDR	3-360
d. Generate command MDR providing merge of playback, card, or tape data	3-360
e. Recovery of SDR and other key command information after failure	3-360
f. Command/monitor interface	3-360
g. Modify DTV stack recall display	3-360
h. Block DTV format of commands entered and for each: transmit time, verify status, enable status, confirm/abort results	3-360 3-DTV
i. Display of "spacecraft event time" and "earth received time" in confirm/abort display	3-360

Table 3. Tracking system

Planned orbital operations capabilities	Reference
A. DSIF	
1. Range data and 10 sample/sec doppler (DTS) to SFOF via HSDL from DSS 14	A-DTS
2. 20 μsec inter-station time synchronization	—
3. Acquire open loop receiver data (Occultation Experiment Support) at DSS 14, 41, and 62 and analog record	—
4. Digitize open loop data in real time at DSS 14	—
5. Digitize, at CTA 21, analog recordings of open loop data mailed from DSS 41 and 62	—
B. GCF	
C. SFOF	
1. Hardware	
a. 360/75-1108 electrical interface	4-ELEC
2. 360/75 software	
a. Transfer SDR to 1108 via electrical interface	5-(1)
b. Recovery of SDR after failure	5-(1)
c. MDR (archive) generation and validation	5-(1)
d. Project tape (or equivalent disk) certification	5-(1)
e. Accept spacecraft ephemeris from 1108 via electrical interface	5-(3)
f. 1108 spacecraft ephemeris tape conversions on operational 360/75	5-(3)
g. Add antenna limits to predicts	5-(3)
h. View periods without full predicts run	5-(3)
i. Reduce predict wall clock run time	
(1) Loaded system, 3 DSS, 24 h, Mars orbit—30 min.	5-(3)
(2) Same conditions—15 min.	5-(3)
j. Occultation predicts	5-(3)
k. Pseudo-residual alarms and tolerance setting	5-(2)
l. Pseudo-residual ϕ factor selection	5-(2)
m. Real-time accountability and outage alarms	4-360
n. Tracking Alarms Processor (TAP) DTV display	4-360
o. Generate SDR file of tracking data charged particle and troposphere calibration factors (MEDIA)	4-360
p. Fix discrepancies	
(1) Comm Processor/360 tracking software "channel" data transfer problem	4-360
(2) Predict track syn. freq. logic, including display	5-(3)
(3) Add "Sign" to printout of TRAG records and DRVID	4-360
(4) Add spacecraft frequencies to ϕ factor check tape	5-(3)
q. Process high speed metric data from DTS	
(1) Basic I/O logic	4-360
(2) Display of data and alarm blocks	4-360
(3) All other processing same as TTY data	4-360
r. Compute timing polynomials in background mode (PLATO)	4-360
s. Tracking data selection for transmission to Project	4-360
t. Light-time interface to other systems/programs	4-360
u. Add pseudo-residual quality index to SDR	4-360
v. Locked file in predicts to allow controlled changes of constants	5-(3)

Table 4. Monitor system

Planned orbital operations capabilities	Reference
A. DSIF	
B. GCF	
C. SFOF	
1. 360/75 SFOF monitor software	
a. Acquire and display status/configuration of 360/75 computer, input/output devices, and interfaces with 1108 and communications processor	6-360
b. Accept status data from SFOF telemetry and command software	6-360
2. 360/75 DSN monitor software	
a. Accept and display data from SFOF monitor software	6-360
b. Assemble monitor criteria data and use to generate alarms (including new requirements)	6-360
c. Display alarms on digital TV and character printer	6-360

Table 5. Operations control system

Planned orbital operations capabilities	Reference
A. DSIF	
1. Display telemetry/RF predicts on line printer as received via high speed from SFOF	7-DIS
2. Generate antenna pointing system drive tape from tracking predicts via high speed or TTY	7-APS
B. GCF	
C. SFOF	
1. 360/75 Operations control software	
a. Sequence of Events Generation (SEG) program, real time, meeting negotiated requirements of SRD DSW-2-3040	7-360
b. 1443 page print of output routed traffic	7-360
c. Repair output router floating point	7-360
d. TTY multiple routing indicator	7-360

Table 6. Simulation system

Planned orbital operations capabilities	Reference
A. DSIF	
1. All capabilities available for launch also available at DSS 14 and 62	8-SCA
2. Accept high rate data via WBDL and generate fixed high rate pattern at DSS 14 and CTA 21	8-SCA
3. Perform automatic signal attenuation on carrier	8-ATT
B. GCF	
1. High speed data between Simulation Center and DSS 12, 14, 41, 51, 62, and SFOF	8-HSD
2. Wideband data between Simulation Center and DSS 14, CTA 21 and SFOF	8-WBDL
C. Simulation center (SIMCEN)	
1. 6050 software	
a. Generate maneuver responsive TTY tracking data for up to three DSS	8-6050
b. Accept high rate science data from digital recording	8-6050
c. Format and distribute b. to DSS 14 and CTA 21 via wideband, simultaneous with HSDL telemetry activity	8-6050
d. Format and distribute b. to SFOF via wideband, simultaneous with HSDL telemetry, command, tracking, and monitor activity	8-6050
e. Simulate DTS tracking data interaction with SFOF via HSDL, simultaneous with c. and/or d.	8-6050
f. Format and distribute engineering and 50 bps science via HSDL	8-6050
D. SFOF	
1. Generate on 360/75 time-ordered ϕ factor tapes for tracking simulation input	8-360

Table 7. Intersystem

Planned orbital operations capabilities	Reference
A. DSIF	
1. One 920 computer must perform the following processing simultaneously:	1-TCP 3-TCP
a. Telemetry: one 2.025 kbps plus one 33⅓ (including TTY engineering) or one 50 bps plus one 33⅓ (including TTY engineering and science)	
b. Command: maximum activity for one spacecraft	
c. Other: DIS interface, AGC and SNR conversions, lock status handling	
B. GCF	
1. One 4.8 kbps HSDL must carry a maximum load consisting of:	1-HSD 3-HSD 6-HSD$_1$
a. Telemetry: one 2.025 kbps plus 33⅓ bps engineering	
b. Command: traffic representative of two command transmissions per minute	
c. Monitor: 14 blocks per minute	
C. SFOF	
1. Perform the following processing simultaneously (refer to each system for details):	1-360 3-360
a. Telemetry: real-time processing of any legal combination of MM '71 data (one live and one simulated spacecraft)	4-360 6-360 7-360
b. Command: real-time processing (one spacecraft)	
c. Tracking: real-time processing, including pseudo-residuals, plus predicts (one live and one simulated spacecraft). Includes high speed tracking data from DTS	
d. Monitor: all real-time processing	
e. Operations Control: output routing of predicts, sequence or schedule	
f. Other large (analysis) programs, including: MDR/EDR, COMGEN, SEG, SPOP, SCISIM, AMPS, LIBSET, OCCULTATION, SCILIB, UVS DISPLAY, IRR DISPLAY	

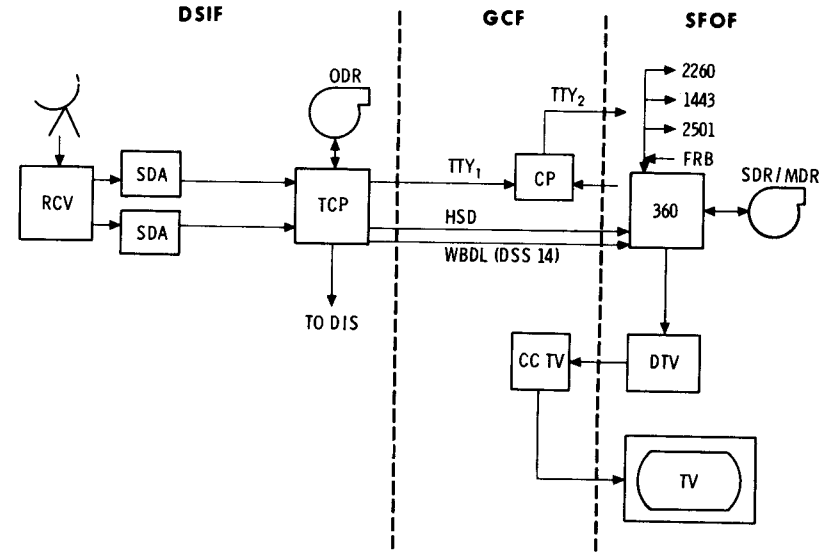

Fig. 1. Telemetry system

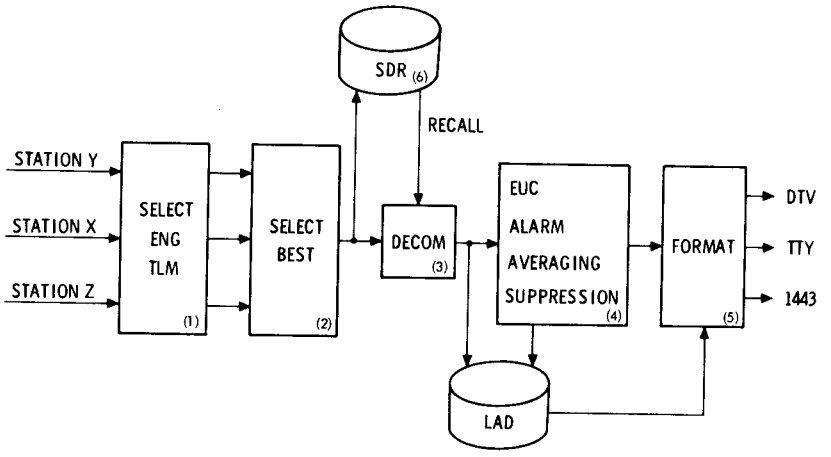

Fig. 2. Telemetry inside the 360 computer

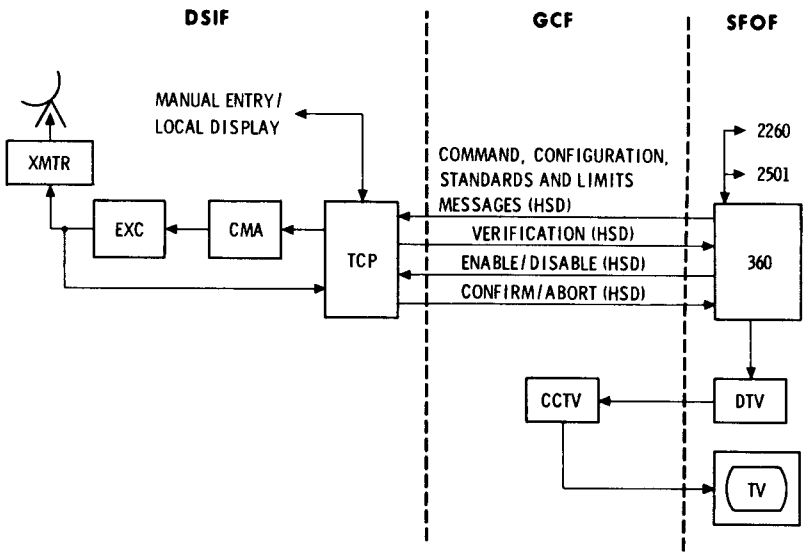

Fig. 3. Command system

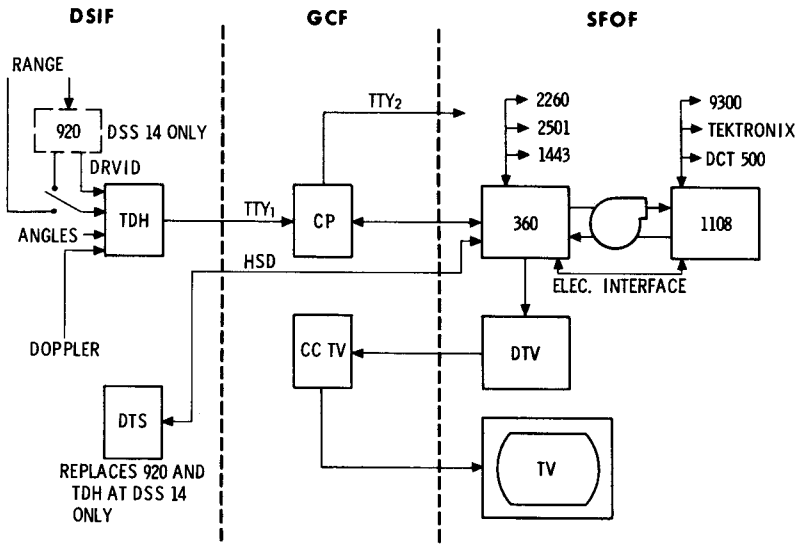

Fig. 4. Tracking system

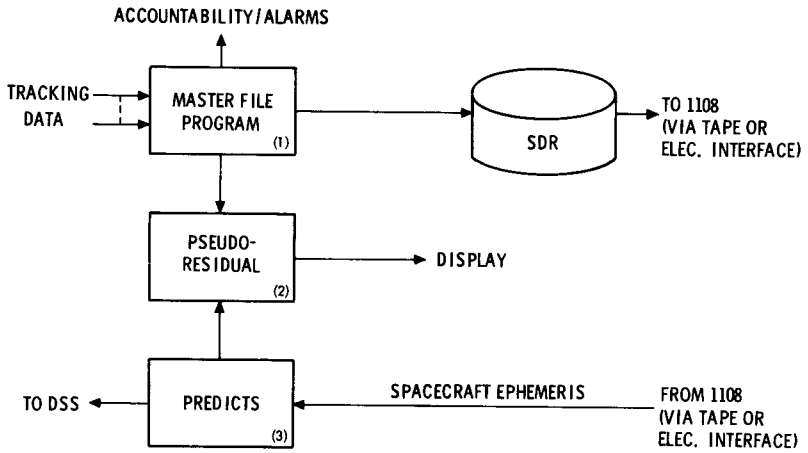

Fig. 5. Tracking inside the 360 computer

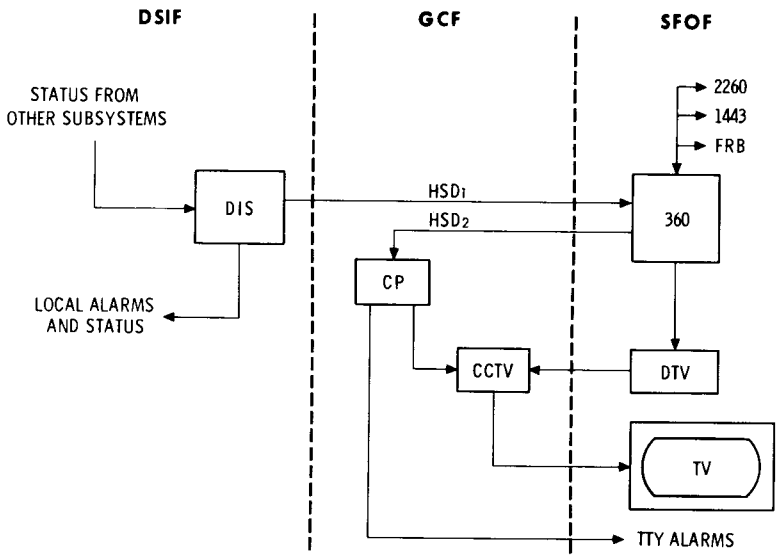

Fig. 6. Monitor system

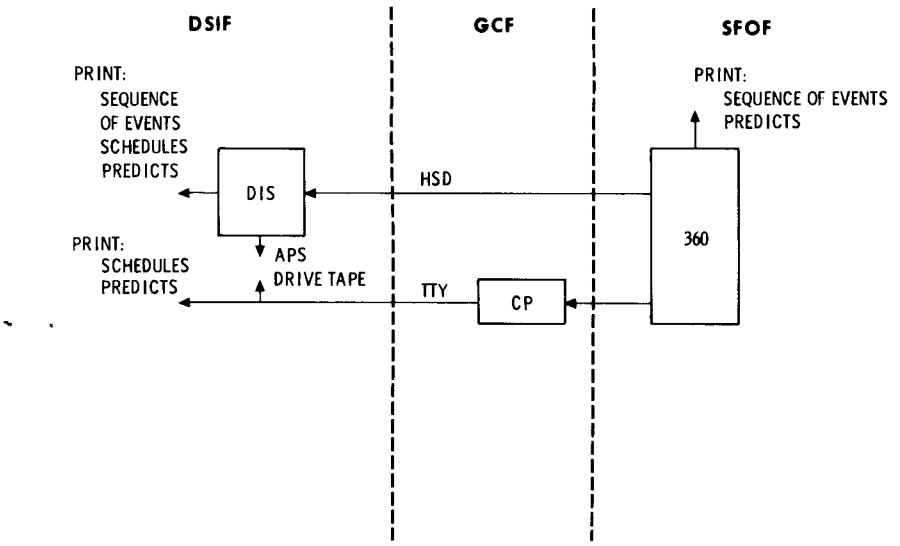

Fig. 7. Operations control system

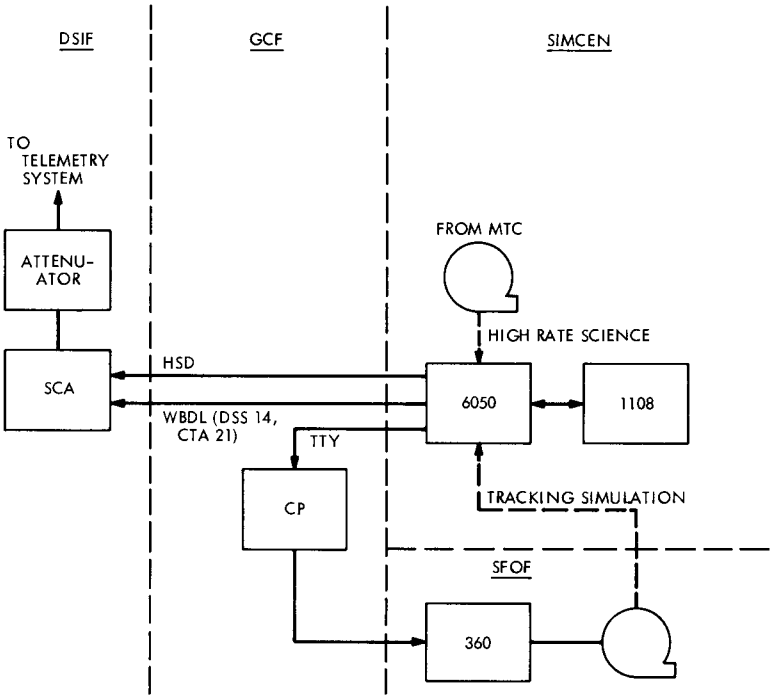

Fig. 8. Simulation system